REQUEST FOR FILING A PATENT APPLICATION UNDER 37 C.F.R. §1.53(b)

Attorney Docket: 622/40901C2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Box PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

This is a request for filing a X continuation or ____ divisional application under 37 C.F.R. 1.53(b), of pending prior application:

Serial No. 08/962,776
Filed on November 3, 1997
Of Roman SCHERTLER

Entitled: A VACUUM PROCESS APPARATUS
Examiner: I. ROSENBAUM
Group: 3726
Batch No: ____

X 1. Accompanying this order is a true copy of the prior reissue application as originally filed. Total pages: 14

X 2. Formal drawings are being filed herewith consisting of 5 sheets, depicting Figures 1-9.

X 3. Declaration and Power of Attorney:

a. ____ Newly executed (original or copy)

b. X Copy from prior application

i. ____ Deletion of Inventors - signed statement attached deleting inventor(s) named in the prior application

X 4. Incorporation by Reference:

The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 3b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

X 5. Cancel original claims 1-34.

_____ 6. Small entity status:

a. _____ A small entity statement is enclosed

b. _____ A statement of small entity status (copy attached) was filed on _____ _____ in the prior application and status as a small entity is still proper and desired.

c. _____ Is no longer claimed

__X__ 7. The filing fee is calculated below:

CLAIMS AS FILED, INCLUDING ANY CLAIMS CANCELLED OR ADDED BY PRELIMINARY AMENDMENT

Basic Fee			$345		$690
Total Claims	38 - 20 = 18	x 9 =	$_____	18 =	$324.00
Ind. Claims	7 - 3 = 4	x 39 =	$_____	78 =	$312.00
_____ Multiple Dependent Claims		+ 130 =	$_____	260 =	$_____
		Total	$_____		$1,326.00

_____ 8. Please charge my Deposit Account No. 05-1323 (Docket #_____) in the amount of $_____.

__X__ 9. A check in the amount of $1,326.00 to cover the filing fee is enclosed.

__X__ 10. The Commissioner is authorized to charge any fee which may be required under 37 CFR 1.16 or 37 CFR 1.17 or credit any overpayment to Deposit Account No. 05-1323 (Docket #622/40901C2).

__X__ 11. Amend the specification by inserting before the first line the sentence: --This application is a continuation of application Serial No. 08/962,776, filed November 3, 1997, which is a continuation of Reissue Application Serial No. 08/530,778, filed September 19, 1995, which is a reissue of Application Serial No. 888,111, filed May 26, 1992 (patented September 21, 1993 as U.S. Patent No. 5,245,736).--

__X__ 12. Priority of Appln. No(s). 4117969, filed in Germany on 31 May 1991, is hereby claimed under 35 U.S.C. 119.

_____ 13. A certified copy of each said priority document was filed in application Serial No. _____ on _____.

X 14. The prior application is assigned of record to Balzers Aktiengesellschaft.

X 15. The power of attorney in the prior application is to:

Herbert I. Cantor, Reg. No. 24,392; James F. McKeown, Reg. No. 25,406; Donald D. Evenson, Reg. No. 26,160; Joseph D. Evans, Reg. No. 26,269; Gary R. Edwards, Reg. No. 31,824; Jeffrey D. Sanok, Reg. No. 32,169; and Corinne M. Pouliquen, Reg. No. 35,753.

X a. The power appears in the original application papers in the prior application.

_____ b. Since the power does not appear in the original application papers, a copy of the power in the prior application is enclosed.

_____ c. Attached is a duplicate of a Supplemental Declaration which was filed in the prior application to overcome informalities.

X d. Address all future correspondence to:

EVENSON, McKEOWN, EDWARDS
& LENAHAN, P.L.L.C.
1200 G Street, N.W.
Suite 700
Washington, DC 20005

X 16. Forms PTO-892 and PTO-1449 listing prior art made of record in the prior application are attached. A copy of each of the listed references should be available in the prior application file.

X 17. A Preliminary Amendment is being filed herewith.

X 18. Return Receipt Postcard.

_____ 19. Other: _____

Respectfully submitted,

July 19, 2000

James F. McKeown
Registration No. 25,406

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Attorney Docket: 622/40901C2
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: ROMAN SCHERTLER

Serial No.: NOT YET ASSIGNED Group Art Unit: 3726

Filed: July 19, 2000 Examiner: I. Rosenbaum

Title: A VACUUM PROCESS APPARATUS

PRELIMINARY AMENDMENT

BOX NEW APPLICATION July 19, 2000
Commissioner for Patents
Washington, D.C. 20231

Sir:

The following preliminary amendment is submitted for consideration prior to calculation of fees and an action on the merits.

IN THE CLAIMS:

Please cancel Claims 1-34 and substitute the following claims therefor:

35. A vacuum process apparatus for processing at least one workpiece, comprising a chamber with

two openings defining respective opening areas; and

a transport device having a drive shaft rotatable around a rotational axis of said drive shaft;

two conveyors for at least one workpiece each, and a transport arm for each conveyor mounted opposite each other to said draft shaft;

said arms being operatively coupled to said conveyors to move said conveyors independently of each other relative to said draft shaft.

36. The apparatus of Claim 35, said openings defining an opening area each, with normals on said opening areas being rectangularly arranged with respect to said rotational axis.

37. The apparatus of Claim 35, wherein said conveyors are movable normally with respect to said draft shaft.

38. The apparatus of Claim 35, wherein said conveyors, once positioned adjacent one of said openings by rotation of said transport device, are movable towards and from said opening in a normal direction of said opening areas.

39. The apparatus of Claim 35, wherein rotation of said transport device around said rotational axis substantially define a cone-shaped trajectory surface with a cone opening angle with respect to said rotational axis of 90°.

40. The apparatus of Claim 39, wherein each of said openings defines an opening area, with normals on said opening areas pointing in a direction of respective generatrix of said cone-shaped trajectory surface.

41. The apparatus of Claim 40, wherein said openings are arranged along a circle cut by said cone-shaped trajectory surface by a geometric plane arranged perpendicularly to said rotational axis.

42. The apparatus of Claim 35, said transport device residing within said chamber further comprising a load lock chamber and a treating station communicating by one of said openings with said chamber.

43. The apparatus of Claim 42, further comprising gas inlet means and pumping means at least at one of said station and chamber.

44. The apparatus of Claim 35, wherein said conveyors comprise a seal member for sealingly closing one of said openings when said conveyors are rotated adjacent to said openings by said transport device.

45. The apparatus of Claim 44, wherein said seal member is formed by a conveyor plate for said workpiece.

46. The apparatus of Claim 35, wherein each said conveyor comprises a conveyor plate with a projecting positioning pin for positioning a disk shaped workpiece with a central bore.

47. The apparatus of Claim 46, further comprising holding means for said workpiece on said conveyor plate.

48. The apparatus of Claim 47, said holding means being formed by spring means acting radially with respect to said pin.

49. The apparatus of Claim 35, said workpiece being one of compact disk workpieces and of magneto-optical storage disk workpieces.

50. The apparatus of Claim 36, said two conveyors being linearly movable towards and from said axis by respective drives provided at said respective arms.

51. The apparatus of Claim 50, wherein said drives are encapsulated by bellows.

52. A vacuum chamber for processing at least one workpiece, comprising two openings defining respective opening areas; a transport device with a draft shaft for rotating said transport device around a rotational axis of said draft shaft; two conveyors and a transport arm for each conveyor mounted opposite each other to said drive shaft and each being operatively coupled to one of said conveyors to move said conveyors independently of each other relative to said drive shaft.

53. The chamber of Claim 52, wherein each of said openings defines an opening area with, normals on said opening areas being rectangularly arranged with respect to said rotational axis.

54. The chamber of Claim 52, wherein said conveyors are movable normally with respect to said rotational axis.

55. The chamber of Claim 52, wherein said conveyors, once positioned adjacent one of said openings by rotation of said transport device, are movable towards and from said opening in a normal direction of said opening areas.

56. The chamber of Claim 52, wherein rotation of said transport device around said rotational axis substantially defines a cone-shaped trajectory surface with a cone opening angle with respect to said rotational axis of 90°.

57. The chamber of Claim 54, wherein each of said openings define an opening area with, normals on said opening areas pointing in a direction of respective generatrix of said cone-shaped trajectory surface.

58. The chamber of Claim 55, wherein said openings are arranged along a circle intersected by said cone-shaped trajectory surface by a geometric plane arranged perpendicular to said rotational axis.

59. The chamber of Claim 52, wherein said conveyors comprise a seal member for sealingly closing one of said openings when said conveyor are rotated adjacent to said openings, by said transport device.

60. The chamber of Claim 57, wherein said seal member is formed by a conveyor plate for said at least one workpiece.

61. The chamber of Claim 52, wherein said conveyors comprises a conveyor plate with a projecting positioning pin for positioning a disk shaped workpiece with a central bore.

62. The chamber of Claim 59, further comprising holding means for said at least one workpiece on said conveyor plate.

63. The chamber of Claim 52, wherein said holding means is formed by spring means acting radially with respect to said pin.

64. The chamber of Claim 52, wherein said conveyors are configured to hold workpieces in the form of one of compact disk workpieces and of magneto-optical storage disk workpieces.

65. The chamber of Claim 52, wherein said conveyors comprise a support plate with an upstanding pin; spring loaded holding portions around said pin being biased radially outwardly with respect to said pin, and further comprising holding portions

projecting outwardly with respect to said pin and being biased slightly outside the surface of said pin.

66. The chamber of Claim 53, said two conveyors being linearly movable towards and from said axis by respective drives provided at said respective arms.

67. The chamber of Claim 66, wherein said drives are encapsulated by bellows.

68. A vacuum chamber with two openings and a workpiece transport arrangement with which at least one workpiece within the chamber is selectively brought into a position adjacent to one of said openings, whereby the transport arrangement is provided within the chamber rotatably around a rotational axis and carries two members for holding a workpiece each, a rotation drive is provided to rotate said workpiece transport arrangement, and two displacement drives are provided for displacing said at least one workpiece each with respect to said transport arrangement whereby said members are selectively brought into a position aligned with one of said openings by rotation of said transport arrangement and from such position a workpiece is displaceable towards and from said opening by one of said displacement drives, and said member and said displacement drives are operatively mounted on said transport arrangement rotation drive.

69. A vacuum chamber with two openings and a workpiece transport arrangement with which at least one workpiece within the chamber is selectively brought into a position adjacent to one of said openings, whereby the transport arrangement is provided within the chamber rotatably around a rotational axis and carries two members for holding a workpiece each, a rotation drive is provided to rotate said workpiece transport arrangement, and two displacement drives are provided for displacing said at least one workpiece each with respect to said transport arrangement whereby said members are selectively brought into a position aligned with one of said openings by rotation of said transport arrangement and from such position a workpiece is displaceably towards and from said opening by one of said displacement drives in a direction radial relative to said rotational axis, and said displacement drives are operable independently of each other.

70. A vacuum chamber, comprising two openings defining respective opening areas; and a transport device operatively arranged relative to the at least two openings and including a member movable relative to a rotational axis thereof, two conveyors for transporting at least one workpiece each, and a linear drive for each of said at least two conveyors being operatively coupled between said movable member and a respective conveyor of said at least two conveyors and configured to linearly move said respective conveyors relative to said movable

member independently from the other conveyor of said two conveyors.

71. A vacuum chamber with two openings and a workpiece transport arrangement with which at least one workpiece within the chamber is selectively brought into a position adjacent to one of said openings, whereby the transport arrangement is provided within the chamber rotatably around a rotational axis and carries two members for holding a workpiece, a rotation drive is provided to rotate said workpiece transport arrangement, and a sealed displacement drive is arranged between said transport arrangement and said two members for displacing a workpiece with respect to said transport arrangement, whereby said members are both selectively brought into a position aligned with one of said openings by rotation of said transport arrangement by 180° and from such position a workpiece is displaceable towards and from said openings by said displacement drives, and said members and said displacement drives are operatively mounted relative to said transport arrangement rotation drive.

72. A method of processing at least two workpieces, comprising the steps of rotating a transport device member around a rotational axis by 180° to bring the two workpieces adjacent an opening in a vacuum chamber having at least two openings, and moving two conveyors radially relative to said rotational axis, independently of each other relative to the transport device

member so as selectively to move the two workpieces towards and away from the adjacent openings.

REMARKS

If there are any questions regarding this Preliminary Amendment or this application in general, a telephone call to the undersigned would be appreciated to expedite the prosecution of the application.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response. Please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #622/40901CO).

Respectfully submitted,

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VACUUM PROCESS APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a vacuum process apparatus of the kind, including at least two stations for treating or handling the workpiece, and a transport device with conveyor means thereon, each for transporting at least one workpiece from station to station.

2. Description of the Prior Art

The German specification DE-A-24 54 544 and "Patent Abstracts of Japan", Nov. 28, 1989, vol. 13, no. 532, JP-A2 1-218 627, disclose as an example such a vacuum process apparatus which includes at least two stations, each comprising an opening for an article, the openings each determining an opening area with surface normal A_n perpendicular to the opening area F such as illustrated in FIG. 1 for sake of clarity. The said apparatus further includes a transport device which is supported and driven to rotate around a space axis as rotational axis and includes at least one conveyor portion for an article, whereby the conveyor portion is moved consecutively to and from the openings of the stations.

In contrary to the design of the apparatus according to the JP-1-218627, the transport device of which comprising only one conveyor portion for an article and whereat the conveyor portion is rigidly fixed on a rotatable cylinder forming the transport device, the apparatus according to the German patent no. 24 54 544 comprises four conveyor portions for articles. These conveyor portions are additionally movable with respect to the transport device. By means of a driving plunger there is realized for each conveyor portion an individual drive for moving the said conveyor portion of the transport device relative to a respective station.

Thus, according to the apparatus of the German patent no. 24 54 544, the conveyor portion may be positioned at different positions with respect to a respective station, according to the specific requirements of a process performed at the station considered, up to providing for a sealing closure of the said opening by means of the conveyor portion.

Provision of the said driving plungers which are led through the wall of the vacuum recipient has different drawbacks:

a) For every driving plunger there must be provided a dynamic gliding vacuum seal which results in a considerable additional expenditure for the apparatus in view of vacuum technical requirements for such dynamic seals.

b) The said driving plungers are individually associated to respective stations. Thus, if an apparatus or vacuum plant shall be changed by changing the number of process stations mounted thereon and especially shall be changed by raising the number of such process stations provided, the complete apparatus with its vacuum recipient must be changed according to the changing number of vacuum tight mounted driving plungers.

It is a first object of the present invention to remedy these drawbacks and to provide a vacuum process apparatus which comprises a self-comprised transport device which may flexibly be used for a great number of different apparatus configurations with respect to the number of the process stations provided.

The design of vacuum process apparatuses according to the DE-A-24 54 544 which have established themselves on the market has the further drawback that the

rotational axis around which the transport device is rotatable extends parallel to the normals of the opening areas. Thereby the openings of the stations are distributed equidistantly around the rotational axis i.e. the rotational axis of the transport device, so that, as an advantage, the openings of the stations can be served solely by a pivoting movement of the transport device around the rotational axis. Nevertheless, it is disadvantageous that when designing the vacuum process apparatus, there is a restriction in constructional freedom, in that the individual stations must be located with the said normals of their opening areas extending parallel to the rotational axis of the transport device. This necessitates that the stations must be arranged in one given orientation with respect to the transport device, possibly may be provided at both sides of the plane swept over by the transport device of said DE-A-24 54 544.

It is thus a further object of the present invention to remedy this drawback and to provide a vacuum process apparatus with a transport device-to station openings-relation which allow a significantly improved constructional freedom for such apparatus.

SUMMARY OF THE INVENTION

It is thus a first object of the present invention to provide a vacuum process apparatus of the kind mentioned above which comprises a transport device which may be used flexibly for different apparatus configurations as concerns number of treating or handling stations provided thereon.

It is a further object to provide a vacuum process apparatus which gives a high degree of constructional freedom with respect to the arrangement of the said stations as concerns their orientation in space and especially the spatial arrangement of their respective openings. Thereby it shall be made possible to vastly increase the compactness of such process apparatuses, thereby optimizing assembly, disassembly, operation cycle time etc.

A further object of the invention is to provide a vacuum process apparatus for processing at least one workpiece, comprising at least two stations for treating or handling said workpiece, and having each at least one opening for the workpiece; a transport device rotatable around an axis; a drive arrangement for rotating said transport device; at least two conveyor means arranged at said transport device for at least one workpiece each; driving means at said transport device respectively coupled to said conveyor means to individually move said conveyor means relative to said transport device towards and from said openings.

By providing such a vacuum process apparatus the disadvantages of the prior art apparatus as concerns lack of flexibility with respect to arranging more or less of the said stations at the apparatus are remedied and further the self-contained transport device with conveyor means and said driving means enables to drive said conveyor means without necessity of frictional seals at the process apparatus vacuum chamber wall, through which, according to prior art, such driving means did act on the conveyor means of the known transport device.

It is still an object of the present invention to provide said apparatus with openings defining an opening area each, the normals on said areas being warped with respect to said rotational axis.

It has been recognized basically that, when providing a transporting device which is rotatable around the said axis and wherearound the openings of the said stations are arranged so that the normals on the areas defined by the respective borders of said openings are warped with respect to the said rotational axis, a highest grade of constructional flexibility is gained in order to design apparatuses more compact and/or to produce smallest possible spaces to be evacuated and/or to minimize cycle time of processing due to minimizing the conveyant distance between respective openings of the stations.

It is yet a further object to provide the said apparatus wherein said conveyor means are movable at least one of parallel to said axis and of radially to said axis. Thereby, departing from the rotational axis of the transport device, by appropriate selection of the movability of the said conveyor means, parallel and/or radial with respect to said axis, it becomes possible to reach openings of the said stations arranged with respect to the rotational axis in a great variability of different positions.

A further object of the present invention is to provide said apparatus wherein said conveyor means, once positioned adjacent one of said openings by rotating said transport device, are movable towards and from said opening in a direction given by the normal on the opening area defined by the said opening. Thereby an even simplified apparatus is realized in that it becomes possible to convey a workpiece disposed on the conveyor means considered straight ahead towards or into or through the opening of a station considered.

Yet a further object is to provide the said apparatus wherein rotation of the transport device around the rotational axis defines a cone-shaped trajectory surface with a cone opening angle with respect to the said rotational axis smaller or equal than 90°.

Although the inventive transport device can, if necessary, sweep over selectably variable conical surfaces, in that the cone angle ϕ is drivingly changed, it has been recognized that a substantial simplification may be reached without any substantial loss with respect to flexibility by the facts that the transport device comprises a transport arm for each of the said conveyor means which arms projecting from the said rotational axis. If the transport device structure with the said transport arms sweeps a conical trajectory surface with an opening angle with respect to the rotational axis up to 90°, by controllably changing the extent of the said transport arms with the conveyor means, station openings may be served along the said conical trajectory surface and located on different great circles of the said cone surface. Thereby, the arms advantageously comprise the said driving means.

Furthermore, the normals on the opening areas of the station openings must not necessarily extend in the direction of the generatrix lines of the conical trajectory surface. These normals can rather extend in an arbitrary direction and in this case at least the conveyor means are accordingly pivoted to finally serve respective openings.

It is, nevertheless, a further object to provide said vacuum process chamber wherein the said normals of said areas point in direction of respective generatrix lines of the trajectory cone surface. This leads to a further simplification of the apparatus, in that linear movement of the said conveyor means in direction of

said transport arms will suffice to respectively serve the station openings.

Even in this case it is still possible to stagger the openings of the stations along different great circles of the conical trajectory surface. This is nevertheless not always necessary and may lead to problems in that stations staggered on different great circles and with openings along the same generatrix and thus substantially aligned in generatrix direction may cover each other, making access to the said openings by said conveyor means more difficult.

It is, thus, a further object of the invention to provide a vacuum process apparatus in which the said openings of the stations are located substantially along one single great circle of the trajectory cone surface.

It is still a further object of the present invention to provide a vacuum process apparatus in which the stations communicate by the said openings with the inside of a chamber, said transport device residing within the said chamber. On one hand, by such a design the transport device is protected and further the danger of contamination of the atmosphere prevailing within the stations is decreased because, as mentioned, the openings of the stations communicate with the chamber.

Depending from the desired process or treatment performed within the respective stations, it is a further object to provide the vacuum process apparatus which comprises gas inlet means and pumping means, at least at one of the said stations and of the said chamber.

By providing such gas inlets and pumping means selectively at the said stations and/or the said chamber, one has the freedom to perform with the apparatus different vacuum processes which are allowed or are not allowed to influence each other by atmosphere communication.

It is yet a further object of the invention to provide an apparatus whereon at least one of said conveyor means is coupled to a seal member for sealingly closing the opening of at least one of the said stations. Thereby it becomes possible to sealingly close the respective station which is advantageous if in that station a vacuum process shall be performed which necessitates a clearly defined gaseous atmosphere. The seal member may be formed by a plate-like member of the conveyor means.

Further, the said plate or disk-like member may form one door of a charging or discharging load lock for a workpiece to be charged or discharged with respect to the said chamber or the said plate may be the workpiece support feeding the workpiece through the station opening of a sputtering station whereby the seal member sealing the sputtering station against the chamber wherein the transport device is disposed.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. 1 is a schematic illustration for explaining the relative position of opening, opening area and of the normal thereon;

FIG. 2 is a sectional view of a presently preferred embodiment of the inventive vacuum process apparatus;

FIG. 3 is an illustration of an apparatus according to FIG. 2 or 4, resp. having a trajectory cone surface with

a cone angle of the cone of $\phi=90°$ with respect to the cone axis, shown partly in section;

FIG. 4 is a schematic top view in the direction of the rotational axis of the apparatus according to FIG. 3;

FIG. 5 shows the transport device for disk-shaped articles at an apparatus according to FIGS. 2 to 4;

FIG. 6 illustrates schematically the principle of the inventive apparatus according to FIGS. 2 to 5;

FIG. 7 is a schematic illustration analogue to FIG. 6 of a further embodiment of the inventive apparatus;

FIG. 8 is an illustration in accordance with FIGS. 6 or 7 of a still further embodiment of the inventive apparatus; and

FIG. 9 illustrates schematically a further embodiment of the inventive apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 2 is an illustration designed in section of an inventive vacuum process apparatus in a first configuration. It includes a drive motor 1 on the axis A as physical drive axis 3, to which at least one transport arm 5 is mounted. The axis A_5 of the arm 5 extends at an angle, for instance of 45° relative to the rotation axis A. If the drive axis 3 is caused to rotate by means of the motor 1 such as indicated by ω, the transport arm(s) 5 sweeps over a conical trajectory surface having a cone angle ϕ of 45°. Two stations are illustrated in FIG. 2. A first station 7 is for instance and as illustrated designed as load lock. It includes a first frame 9 and a second frame 11 which can be moved upwards and downwards and which is flanged onto the first frame 9. Inside of the drivingly upwards and downwards movable frame 11 a sealing frame 12 is provided which determines the opening 13 of the station and thus its area, having a surface normal A_{13} of said area. The lock station 7 includes a cover 15 which is linearly displaceable in the direction x. Quite obviously it also can be pivotable for opening and closing, around a vertical axis in FIG. 2. In its closed, illustrated position it is placed sealingly onto the sealing frame 12 by a lowering of the intermediate frame 11 in the direction y.

Thus, the lock station 7 becomes sealed against the environment U.

The transport arm 5 carries at one end as conveyor portion a disk or plate 19 on which an article to be processed rests, in the illustrated example a CD or a magneto-optical storage disk 21, centered at the plate 19 by a central pin 17. As shown by broken lines the plate 19 at the supporting arm 5 can be moved back from its seat (illustrated) at the sealing frame 12 towards the rotation axis A and thus the lock may be opened at the side of the transport device. Because the transport device 3, 5, 19 of the apparatus illustrated in FIG. 2 is located in a vacuum tight chamber K the plate 19 must here not necessarily contact the frame 12 in a sealed manner. This situation is obviously different when the chamber K itself is not vacuum tight. The article 21 is conveyed by the transport arm by rotating of the shaft 3 by means of the motor 1 towards the second station 27 illustrated. The driving arrangement at the transport arm 5, the specific construction thereof not forming part of the present invention, and for which various possibilities regarding its design will come to mind to the person skilled in the corresponding art, is sealed by a bellows 23 in a vacuum tight manner against the interior of the chamber K. By rotating of the transport arm 5, the article, namely e.g. the disk 21, is transported into

the area of an opening 25 of the second illustrated station 27. The opening 25 determines the surface normal A_{25} of the opening area. From the approach position Q illustrated by broken lines, the conveyor plate 19 with the disk 21 is again raised into the position illustrated by full lines by means of the mentioned, for instance pneumatic driving arrangement or mechanism at the arm 5, such that the plate comes to contact, now e.g. in a sealed manner, the edge of the opening 25 of the station 27 which for instance can be designed as a known etching or coating station.

FIG. 2 illustrates that on the one hand the stations 7 and 27 and the flange 29 of the motor 1 are interconnected in such a manner that they encase the closed chamber K in which the transport device with its arm(s) 5 moves. The chamber K for the transport device is preferably structured vacuum tight against the environment U. Depending from the prevailing application or operation units (not illustrated) are foreseen at the station 27 and/or at the chamber K and/or at the station 7 which produce respective atmospheres in an aimed manner. Thus, i.e. lines for evacuation and/or gas inlets are foreseen to the stations 7 and/or 27 and/or to the chamber K. A pumping connection 30 for the chamber K and a gate 7 are illustrated in FIG. 2 as an example.

If the apparatus is designed in such a manner that some or all station openings are sealingly closed by one of the arms 5 foreseen, this leads to the possibility of presetting the respective atmospheres in the respective individual stations independently from the atmosphere in the chamber K. In certain cases, however, it will be absolutely sufficient to foresee a common atmosphere for the stations and the chamber K for the transporting device, so that only the chamber must be conditioned or evacuated, such as for example illustrated in FIG. 2, the chamber K beside the load lock station 7.

FIG. 3 illustrates partly in section an apparatus in which the arms 5 project perpendicularly from the axis 3 of the motor, thus defining for a cone angle ϕ of 90°.

A top view of the apparatus according to FIG. 3 is illustrated in FIG. 4. The same structural members are identified by the same reference numerals. For instance six transport arms 5*a* to 5*f* are arranged around the axis A, analogue as illustrated in FIG. 3. They serve alternatingly a lock station 7 for the charging and removing of e.g. the disks 21 and five further processing stations 27*a* to 27*e*.

In order to treat disk shaped articles such as CD's or magneto-optical disks having a central hole, such as the disk 21 illustrated in FIG. 2, FIG. 5 illustrates a preferred support on the plate 19. Thus, the plate 19 includes at its center a pin 22 which has three axially extending grooves 23 staggered azimutally by 120°. Springs 25 are mounted in these grooves. They project towards the upright end of the pin with portions 26 slightly domed outwards beyond the outer surface of the pin, such that the disk 21 can be easily slid e.g. by means of a charging roboter over these portions and a slight snapping occurs at the portions 26. This depends from how much the portions 26 will project over the deposited disk 21. This slight snapping-on by the disk 21, only slightly over the culmination point P of the portions 26, allows also a more easy drawing-off of the disk 21 after its processing or treatment, resp. without that a drive mechanism being necessary for the retaining springs 25.

The basic principle of the apparatus explained with reference to FIGS. 2 to 4 is schematically illustrated in

FIG. 6. By means of the here e.g. three illustrated transport arms 5*a* to 5*c* which rotate around the rotational axis A, the indicated exemplarily three stations 27 with their openings are served. In the manner as illustrated by the limiting line 29 a transport device chamber K may be formed. During its rotation ω the transport device sweeps over a conical surface having a cone angle ϕ and serves the stations 27 of which the openings 25 determine the surface normal A_{25}. Latter are directed in the direction of generatrix lines of the cone which is swept over. The openings 25 of the stations 27 are located on a great circle of the cone trajectory surface which is swept over, i.e. all have the same distance from the tip S of that cone surface.

In FIG. 7 a further embodiment of the apparatus is schematically illustrated. Here, stations located along the illustrated trajectory cone surface 31 swept over by the arms, are positioned on a first great circle 33 and further stations of which only one is illustrated are located on a second great circle 35. The surface normals A_{25} of the openings extend again in direction of the generatrix lines m of the cone 31. In order to serve the openings 25 of stations 27 which are located on different great circles 33, 35 the arms 5 can be drivingly elongated or shortened such as schematically shown at 37, such as for instance by a pneumatic telescope drive, e.g. covered by a here not illustrated bellows, analogue to the bellows 23 of FIG. 2. Accordingly, it becomes possible to position stations not only on one great circle such as in the apparatus according to FIGS. 2 to 4, but staggered azimutally, α, on a plurality of great circles of the cone 31.

In a further embodiment of the invention according to FIG. 8 the arms can also be elongated or shortened as again shown at 37 and carry a conveyor plate 19*a*. Additionally, the angle ϕ of the trajectory cone is adjustable e.g. in a driven manner such that it is possible to sweep over respective cones having different cone angles ϕ. Accordingly, it is possible to serve stations located arbitrarily within large limits. Additionally, the conveyor plate 19*a* is supported angularly at an angle $\beta \leqq 90°$ at the respective arm 5 and, such as illustrated by p, rotatable around the arm axis A_5. The setting of the cone angle ϕ of the elongating or shortening of the arm and of the rotating amount at p, as well, is preferably accomplished drivingly controlled such that it becomes possible to serve by such an arrangement stations with their openings 25 which are practically positioned arbitrarily regarding their orientation and distribution in space. The preferably foreseen chamber K of the transport device is again indicated by broken lines.

According to FIG. 9 the rotational axis A lies vertically. The arms 5 are L-shaped and mounted so that the conveyor plates 19 lie horizontally. This has the substantial advantage that thus articles on the plates must not be fastened or held, resp. The drive means at the arms for the movement of the plates are positioned inside of bellows 23.

By the inventive concept and a correspondingly designed vacuum process apparatus, it becomes possible to design extremely compact apparatuses having a plurality of individual process stations including load locks, whereby looking back to FIG. 2 it follows automatically that, if desired, optimally short conveyance paths may be realized or the volumes to be conditioned can be minimalized, resp.

While there are shown and described present preferred embodiments of the invention it is to be distinctly

understood that the invention is not limited thereto, but may be otherwise variously embodied and practiced within the scope of the following claims.

I claim:

1. A vacuum process apparatus for processing at least one workpiece, comprising a chamber with[:]

at least two openings defining respective opening areas [for one of treating and handling said at least one workpiece thereat]; and

a transport device[, comprising] having

a drive shaft rotatable around a rotational axis of said drive shaft;

at least two conveyors [arranged at said transport device] for at least one workpiece each[, said transport device comprising], and a transport arm for each conveyor [projecting from] operatively associated with said drive shaft;

said arms being operatively coupled to said conveyors to move said conveyors independently of each other relative to said drive shaft.

2. The apparatus of claim 1, said openings defining an opening area each, with normals on said opening areas being warped with respect to said rotational axis.

3. The apparatus of claim 1, wherein said conveyors are movable at least one of parallel to said drive shaft and of normally with respect to said drive shaft.

4. The apparatus of claim 1, wherein said conveyors, once positioned adjacent one of said openings by rotation of said transport device, are movable towards and from said opening in a normal direction of said opening areas.

5. The apparatus of claim 1, wherein rotation of said transport device around said rotational axis substantially define a cone shaped trajectory surface with a cone opening angle with respect to said rotational axis of not more than 90°.

6. The apparatus of claim 5, wherein each of said openings defines an opening area, with normals on said opening areas pointing in a direction of respective generatrix of said cone-shaped trajectory surface.

7. The apparatus of claim 6, wherein said openings are arranged along a circle cut by said cone-shaped trajectory surface by a geometric plane arranged perpendicularly to said rotational axis.

8. The apparatus of claim 1, said transport device residing within said chamber further comprising at least one of a load lock chamber and of a station for treating said workpiece communicating by one of said openings with said chamber.

9. The apparatus of claim 8, further comprising gas inlet means and pumping means at least at one of said station and chambers.

10. The apparatus of claim 1, wherein at least one of said conveyors comprise a seal member for sealingly closing one of said openings when said at least one conveyor is rotated adjacent to said opening by said transport device.

11. The apparatus of claim 10, wherein said seal member is formed by a conveyor plate for said workpiece.

12. The apparatus of claim 1, wherein each said conveyor comprises a conveyor plate with a projecting positioning pin for positioning a disk shaped workpiece with a central bore.

13. The apparatus of claim 12, further comprising holding means for said workpiece on said conveyor plate.

14. The apparatus of claim 13, said holding means being formed by spring means acting radially with respect to said pin.

15. The apparatus of claim 1, said workpiece being one of compact disk workpieces and of magneto-optical storage disk workpieces.

16. A vacuum chamber for processing at least one workpiece, comprising at least two openings defining respective opening areas [for treating or handling said at least one workpiece thereat]; a transport device with a drive shaft for rotating said transport device around a rotational axis of said drive shaft; at least two conveyors [arranged at said transport device for the workpiece thereat, said transport device further comprising], and a transport arm for each conveyor [projecting from] operatively associated with said drive shaft[; said arms] and each being operatively coupled to one of said conveyors to move said conveyors independently of each other relative to said drive shaft.

17. The chamber of claim 16, wherein each of said openings defines an opening area with, normals on said opening areas being warped with respect to said rotational axis.

18. The chamber of claim 16, wherein said conveyors are movable at least one of parallel to said rotational axis and of normally with respect to said rotational axis.

19. The chamber of claim 16, wherein said conveyors, once positioned adjacent one of said openings by rotation of said transport device, are movable towards and from said opening in a normal direction of said opening areas.

20. The chamber of claim 16, wherein rotation of said transport device around said rotational axis substantially defines a cone-shaped trajectory surface with a cone opening angle with respect to said rotational axis of not more than 90°.

21. The chamber of claim 20, wherein each of said openings define an opening area with, normals on said opening areas pointing in a direction of respective generatrix of said cone-shaped trajectory surface.

22. The chamber of claim 21, wherein said openings are arranged along a circle intersected by said cone-shaped trajectory surface by a geometric plane arranged perpendicular to said rotational axis.

23. The chamber of claim 16, wherein at least one of said conveyors comprise a seal member for sealingly closing one of said openings when said at least one conveyor is rotated adjacent to said opening by said transport device.

24. The chamber of claim 23, wherein said seal member is formed by a conveyor plate for said at least one workpiece.

25. The chamber of claim 16, wherein said conveyors comprises a conveyor plate with a projecting positioning pin for positioning a disk shaped workpiece with a central bore.

26. The chamber of claim 25, further comprising holding means for said at least one workpiece on said conveyor plate.

27. The chamber of claim 16, wherein said holding means is formed by spring means acting radially with respect to said pin.

28. The chamber of claim 16, wherein said conveyors are configured to hold workpieces in the form of one of compact disk workpieces and of magneto-optical storage disk workpieces.

29. The chamber of claim 16, wherein said conveyors comprise a support plate with an upstanding pin; spring loaded holding portions around said pin being biased radially outwardly with respect to said pin, and further comprising holding portions projecting outwardly with respect to said pin and being biased slightly outside the surface of said pin.

30. A vacuum chamber with at least two openings and a workpiece transport arrangement with which at least one workpiece within the chamber is selectively brought into a position adjacent to one of said openings, whereby the transport arrangement is provided within the chamber rotatably around a rotational axis and carries at least two members for holding a workpiece each, a rotation drive is provided to rotate said workpiece transport arrangement, and at least two displacement drives are provided for displacing said at least one workpiece each with respect to said transport arrangement whereby said members are selectively brought into a position aligned with one of said openings by rotation of said transport arrangement and from such position a workpiece is displaceable towards and from said opening by one of said displacement drives, and said member and said displacement drives are operatively mounted on said transport arrangement rotation drive.

31. A vacuum chamber with at least two openings and a workpiece transport arrangement with which at least one workpiece within the chamber is selectively brought into a position adjacent to one of said openings, whereby the transport arrangement is provided within the chamber rotatably around a rotational axis and carries at least two members for holding a workpiece each, a rotation drive is provided

to rotate said workpiece transport arrangement, and at least two displacement drives are provided for displacing said at least one workpiece each with respect to said transport arrangement whereby said members are selectively brought into a position aligned with one of said openings by rotation of said transport arrangement and from such position a workpiece is displaceable towards and from said opening by one of said displacement drives in a direction with a radial component relative to said rotational axis, and said displacement drives are operable independently of each other.

32. A vacuum chamber, comprising

at least two openings defining respective opening areas; and a transport device operatively arranged relative to the at least two openings and including a member movable relative to a rotational axis thereof, at least two conveyors for transporting at least one workpiece each, and at least one linear drive for each of said at least two conveyors being operatively coupled between said movable member and a respective conveyor of said at least two conveyors and configured to linearly move said respective conveyors relative to said movable member independently from other conveyors of said at least two conveyors.

33. A vacuum chamber with at least two openings and a workpiece transport arrangement with which at

least one workpiece within the chamber is selectively brought into a position adjacent to one of said openings, whereby the transport arrangement is provided within the chamber rotatably around a rotational axis and carries at least one member for holding a workpiece, a rotation drive is provided to rotate said workpiece transport arrangement, and a sealed displacement drive is arranged between said transport arrangement and said at least one member for displacing a workpiece with respect to said transport arrangement, whereby said member is selectively brought into a position aligned with one of said openings by rotation of said transport arrangement and from such position a workpiece is displaceable towards and from said opening by said displacement drive, and said member and said displacement drive are operatively mounted relative to said transport arrangement rotation drive.

34. A method of processing at least one workpiece, comprising the steps of

rotating a transport device member around a rotational axis to bring the at least one workpiece adjacent an opening in a vacuum chamber having at least two openings, and

moving at least two conveyors with at least one movement component radial relative to said rotational axis, independently of each other relative to the transport device member so as

selectively to move the at least one workpiece towards and away from the adjacent opening.

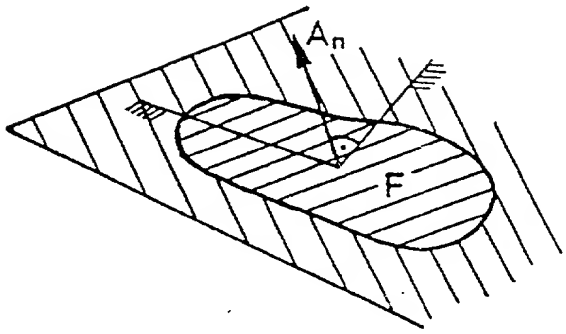

FIG.1

U

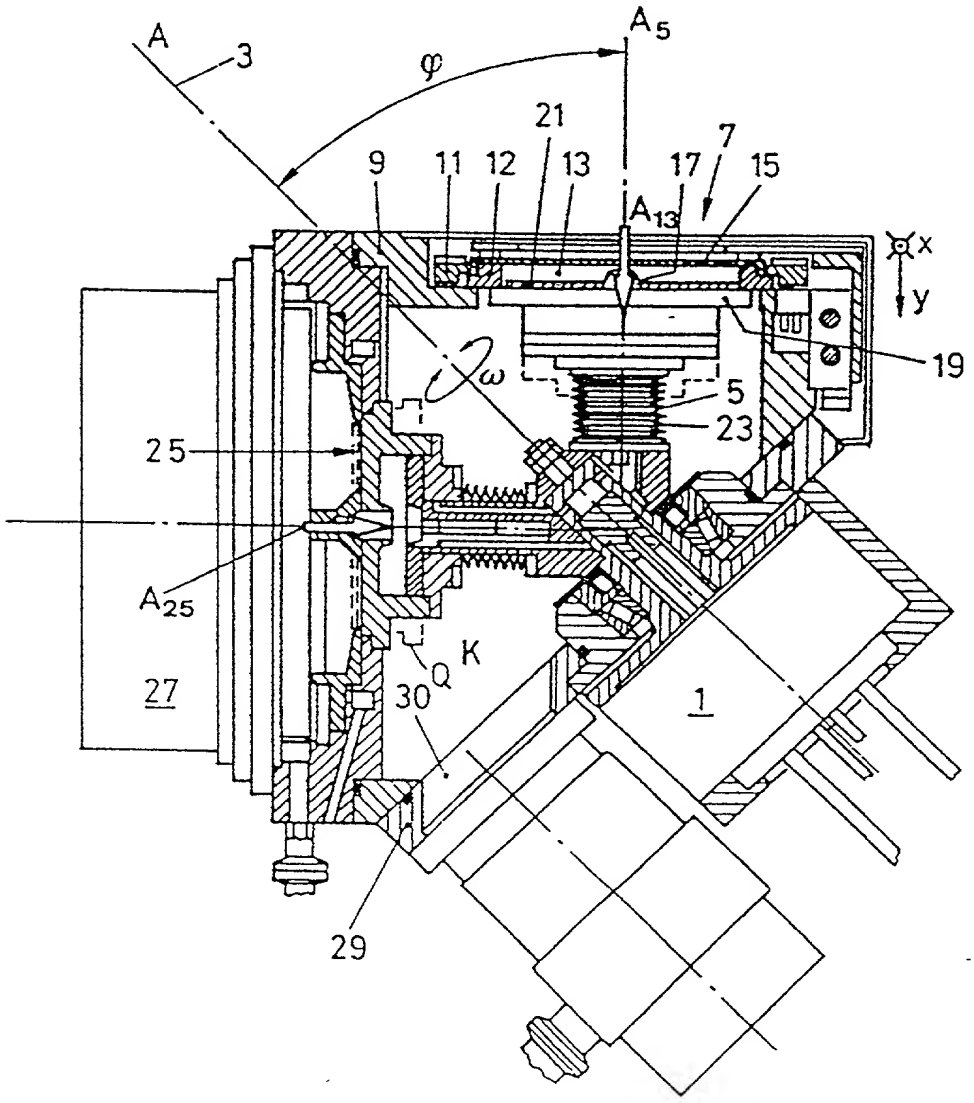

FIG. 2

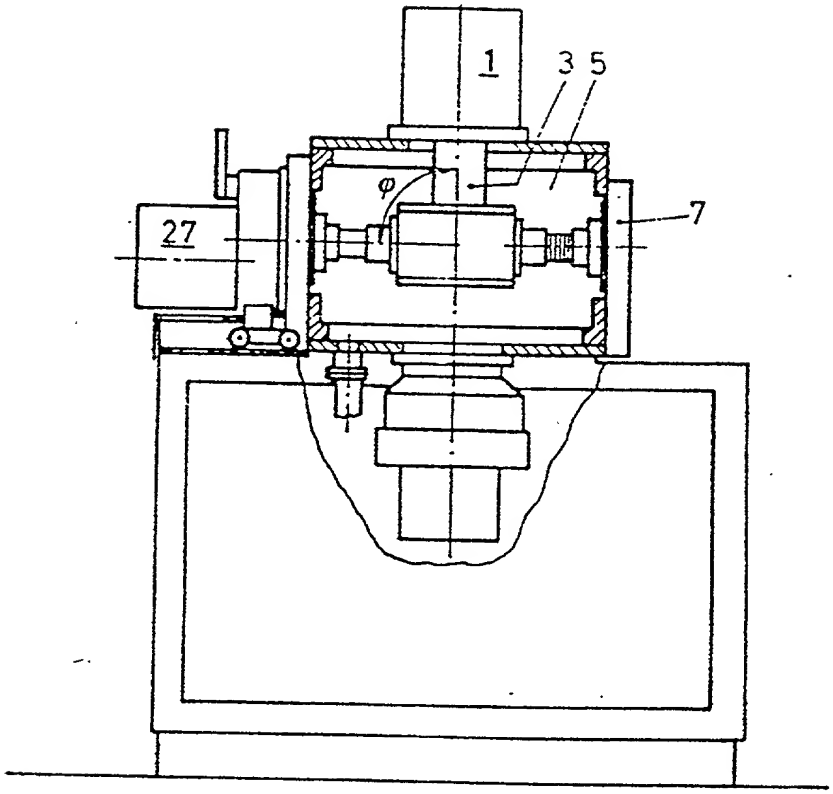

FIG. 3

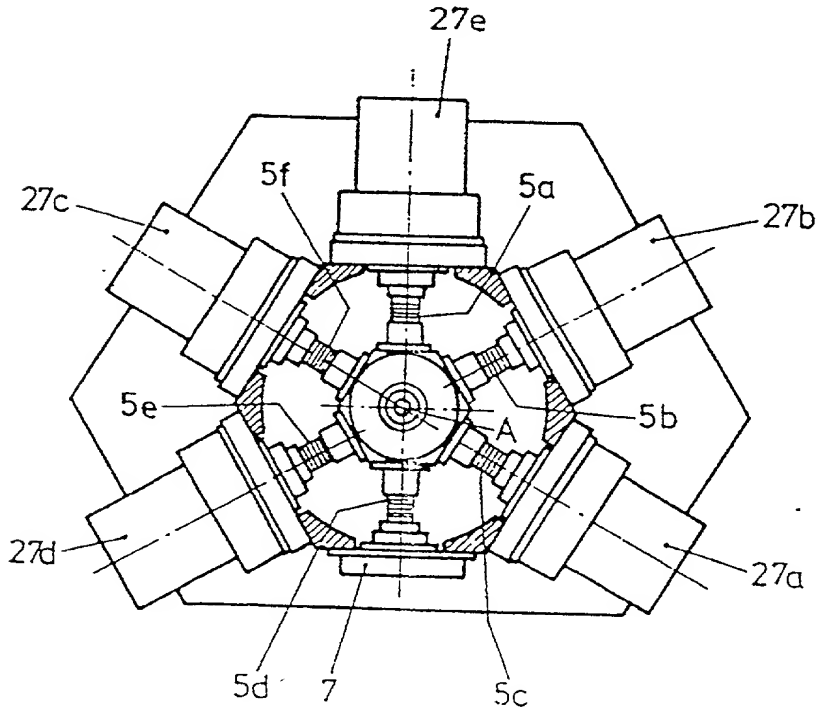

FIG.4

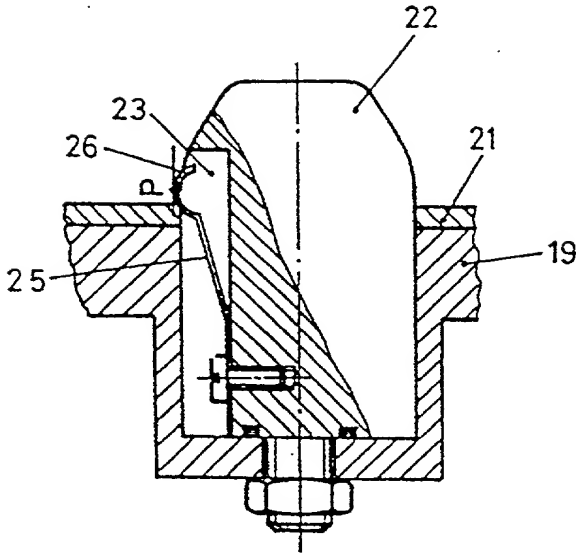

FIG. 5

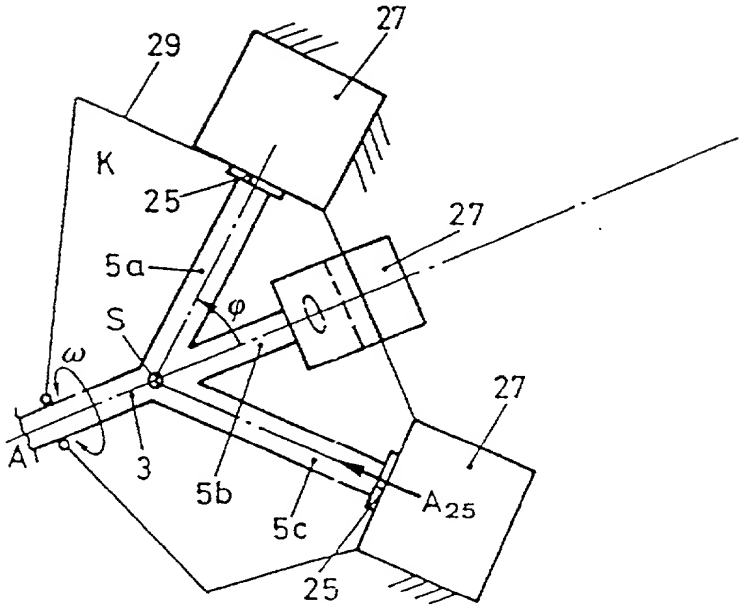

FIG. 6

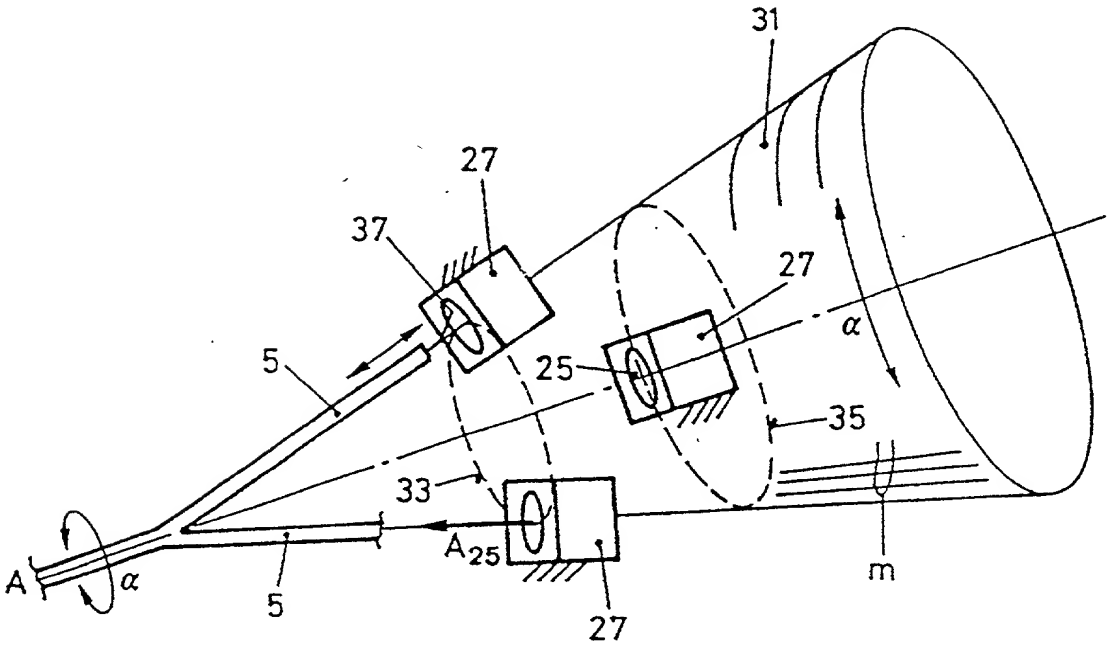

FIG.7

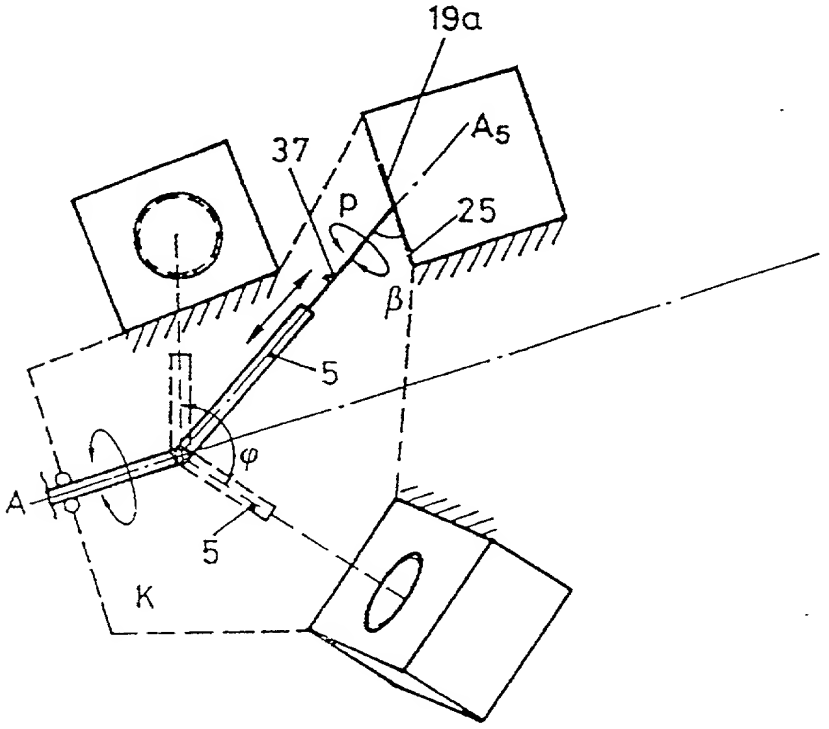

FIG.8

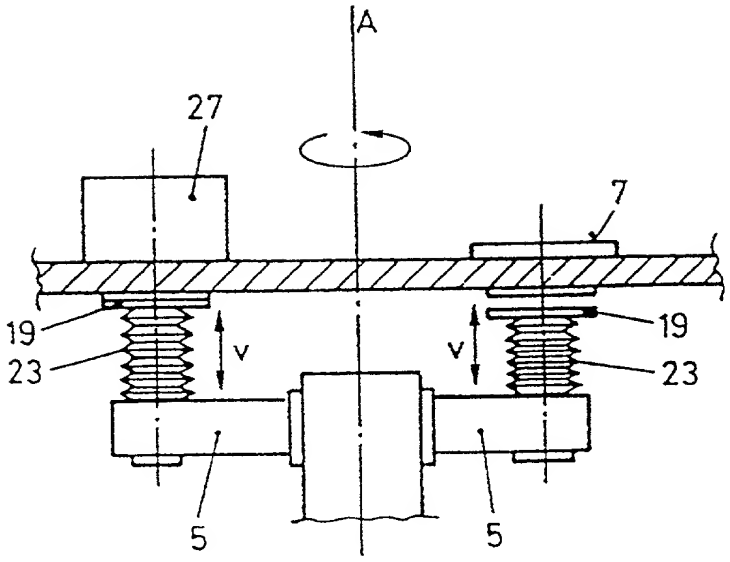

FIG.9

ATTORNEY DOCKET NO.: 622/40901RE
PATENT

DECLARATION AND POWER OF ATTORNEY
REISSUE PATENT APPLICATION

As the below named inventor, I hereby declare that my citizenship, residence postal address and residence are as stated below; that I verily believe myself to be the original, first and sole inventor of the invention entitled:

VACUUM PROCESSING APPARATUS

the specification of which is attached hereto and includes original U.S. Patent No. 5,245,736, issued September 21, 1993, and amendments thereto as required by 37 C.F.R. § 1.171 et seq.

I verily believe that the original U.S. Patent No. 5,245,736 is partly inoperative by reason of the fact that I claimed both more and less than I had a right to claim in the patent as specified hereinafter. In particular, Claims 1 and 16 were insufficient because they did not recite independent movement of the conveyors relative to the drive shaft. However, Claims 1 and 16 also contained unnecessary limitations in reciting that the at least two openings are provided for at least one of treating and handling at least one workpiece thereat, in reciting that the at least two conveyors are arranged at the transport device and in reciting that the transport arm for each conveyor projects from the drive shaft. In addition, Claim 1 also contains formal errors which are correctable by eliminating the colon in line 2, adding --and-- in the fifth line, changing "comprising" to --having-- in the sixth line, eliminating redundant language in the form of ", said transport device comprising" in the tenth and eleventh lines and substituting --and-- therefor, and inserting --drive-- between "said" and "shaft" in the fourteenth line. Likewise, Claim 16 contains formal errors which are correctable by deleting "said transport device further comprising" in the eighth line and adding --, and-- thereafter, eliminating redundant language in the form of "; said arms" and substituting --and-- therefor, and inserting --drive-- between "said" and "shaft" in the eleventh line. Claims 30 through 33 have been added to more comprehensively cover a combination of elements comprising the vacuum chamber. That is, Claim 30 defines at least two holders, at least two displacement drives and the relationship of the holders and displacement drives relative to a rotatable transport arrangement, Claim 31 defines an apparatus which do not require the displacement drives to be coupled to the transport arrangement but does require independently operable drives having a radial movement component. Claim 32 defines a linear drive for each of the conveyors, and Claim 33 defines a rotatable transport arrangement which carries one member for holding a workpiece, and a sealed displacement drive between the transport mechanism and the member. Claim 34 has been added to define the novel and unobvious workpiece processing method described in the Specification in connection with a vacuum chamber and at least two independently movable conveyors.

The assignee of this patent recently discovered the errors in Claims 1 and 16 and the need for additional claims upon reviewing the patent in relation to competitive devices and a reference, namely German Offenlegungsschrift 2529018, whose relevance to the claimed subject matter was only recognized after issuance of this patent. The errors were made without deceptive intention and arose from the unfamiliarity of assignee's counsel with the relevance of said German reference in relation to the original Claims 1 and 16, as well as the competitive devices, and upon further review of claim format after reviewing the necessity to seek reissue of the original claims.

I offer to surrender the original patent and/or provide an appropriate affidavit or declaration in the event the same is lost, upon the indication of allowability of the reissue patent application.

I hereby state that I have reviewed and understand the contents of the above-identified Specification, including the Claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56 (a).

I hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed
4117969 (Number)	Germany (Country)	31 May 1991 (Day/Month/Year)	Yes
_____ (Number)	_____ (Country)	_____ (Day/Month/Year)	_____

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56 (a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

888,111	May 26, 1992	U.S.P. 5,245,736
(Application Serial No.)	(Filing Date)	for which this is reissue appln. (patented 9/21/93).

I hereby appoint as principal attorneys:

Herbert I. Cantor, Reg. No. 24,392; James F. McKeown, Reg. No. 25,406; Donald D. Evenson, Reg. No. 26,160; Joseph D. Evans, Reg. No. 26,269; Gary R. Edwards, Reg. No. 31,824; Jeffrey D. Sanok, Reg. No. 32,169, and Corinne M. Pouliquen, Reg. No. 35,753, to prosecute and transact all business in the Patent and Trademark Office connected with this application and any related United States and international applications. Please direct all communications to:

Evenson, McKeown, Edwards & Lenahan
1200 G Street, N.W., Suite 700
Washington, D.C. 20005
Telephone: (202) 628-8800
Facsimile: (202) 628-8844

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

INVENTOR: Roman Schertler
Citizenship: Austria
Postal Address/Residence: Lorenz Schertlerstrasse 18
6922 Wolfurt, Austria

95/09/14
Date

Roman Schertler
Signature

ASSIGNEE'S CONSENT

Balzers Aktiengesellschaft, assignee of the entire right, title and interest in and to U.S. Letters Patent No. 5,245,736, hereby assents to the filing of the attached application for reissue of said patent in accordance with 37 C.F.R. §1.172.

Balzers 95/09/14

Balzers Aktiengesellschaft
ppa. i.V.

By: U. Wegmann D. Dubois-d.B.